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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Tetsuo NISHIDA et al
Serial No. : 10/563,125
Filed : June 30, 2004
For : QUATERNARY AMMONIUM SALT, ELECTROLYTE, AND
ELECTROCHEMICAL DEVICE
Art Unit : 1626
Examiner : Shawquia Young
Hon. Commissioner of Patents and Trademarks

DECLARATION

Sir:

I, Hiroaki TOKUDA, a Japanese national, residing at
c/o OTSUKA CHEMICAL CO., LTD., 463, Kagasuno, Kawauchi-cho,
Tokushima-shi, Tokushima-ken 771-0193 Japan, declare that:

1. I am one of the applicants of the above-identified application.
2. I have studied the Official Action dated November 16, 2009.
3. I have conducted the following experiments to demonstrate superiority of the present invention over the cited reference.

EXPERIMENT

Experiment (a)

The voltage resistance of BMMPBF₄ (N-ethoxymethyl-N-methylpyrrolidinium tetrafluoroborate) which is a quaternary ammonium salt of Example 30 of the present invention was

measured using a 3-electrode electrochemical cell. Used as the working electrode was a glassy carbon electrode (product of BAS Inc.) 1.0 mm in diameter and 0.0079 cm^2 in electrode area. The reference electrode used was a silver wire (product of the Nilaco Corp., 99.99% in purity) having a diameter of 0.5 mm. The counter electrode used was a platinum electrode (product of BAS Inc. 11-2233) measuring 0.5 mm in diameter and 50 mm in length. Linear sweep voltammetry was carried out to individually determine the potentials giving an oxidizing current density and reducing current density of 0.5 mAcm^{-2} . The difference between the potentials was taken as the voltage resistance. The potential sweep application speed was 50 mVs^{-1} . HZ-3000, product of Hokuto Denko Co., Ltd. was used for electrochemical measurement. EMMPPBF₄ was used as dissolved in propylene carbonate in concentration of 1.5 moles/liter. Experiment (b)

The voltage resistance of EMMPTFSI (N-ethoxymethyl-N-methylpyrrolidinium bistrifluoromethanesulfonylimide) which is a quaternary ammonium salt of Example 31 of the present invention was measured in the same manner as above.

Experiment (c)

The voltage resistance of EMMPCl (N-ethoxymethyl-N-methylpyrrolidinium chloride) which is a quaternary ammonium salt disclosed in Pernak et al, Table 1, 1a was measured in the same manner as above.

The results were shown in FIG. A.

The voltage at 1 mA/cm^2 in oxidation potential are each 3.2 V, 2.9 V and 1.4 V in case of EMMPPBF₄, EMMPTFSI and EMMPCl as shown in FIG. A.

The voltage at -1 mA/cm^2 in reduction potential are each -2.7 V, -2.8 V and -2.3 V in case of EMMPPBF₄, EMMPTFSI

and EMMPCl as shown in FIG. A.

The larger the absolute value of the voltage in both of oxidation potential and reduction potential, the better is voltage resistance. EMMPB₄ and EMMPTFSI are larger in the absolute value compared with that of EMMPCl, hence are excellent in electrochemical stability than EMMPCl.

CONSIDERATION OF THE RESULTS

It can be concluded from the above Experiment that EMMPB₄ and EMMPTFSI are larger in the absolute value compared with that of EMMPCl, hence are excellent in electrochemical stability than EMMPCl.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Executed on March 16, 2010.

Hiroaki Tokuda

Hiroaki TOKUDA